CLAIMS

1. A method of performing a coarse frequency synchronization compensating for a carrier frequency deviation from an oscillator frequency in a demodulation system (130) capable of demodulating a signal having a frame structure comprising at least one useful symbol (162) and a reference symbol (166), said reference symbol (166) being an amplitude-modulated bit sequence, said method comprising the steps of:

   receiving said signal;

   down-converting said received signal;

   performing an amplitude-demodulation of said down-converted signal in order to generate an envelope;

   correlating said envelope with a predetermined reference pattern in order to determine said carrier frequency deviation; and

   controlling said oscillator frequency based on said carrier frequency deviation.

2. The method of claim 1, wherein said carrier frequency deviation is determined as follows:

$$\Delta f = \frac{1}{2\pi T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \tilde{r}(k) \cdot S^{*}_{AM}(k)\right) \qquad \text{(Eq.6)}$$

   wherein $\tilde{r}$ designates values of said envelope of the received signal;

   S^{*}_{AM} designates the complex conjugate of the values of the predetermined reference pattern;

T_{MCM} designates the duration of said useful symbol;

k designates an index; and

L/2 designates the half length of the sequence used for the coarse frequency synchronization.

3. A method of performing a coarse frequency synchronization compensation for a carrier frequency deviation from an oscillator frequency in a demodulation system (130) capable of demodulating a signal having a frame structure, said frame structure comprising at least one useful symbol (162) and a reference symbol (166), said reference symbol (166) being an amplitude-modulated bit sequence which comprises two identical sequences (300), said method comprising the steps of:

receiving said signal;

down-converting said received signal;

performing an amplitude-demodulation of the down-converted signal in order to generate an envelope, said envelope having two portions which are based on said identical sequences (300);

correlating one of said portions of said envelope with another one of said portions in order to determine said carrier frequency deviation; and

controlling said oscillator frequency based on said carrier frequency deviation.

4. The method of claim 3, wherein said correlating step further comprises weighting of corresponding values of said two portions with corresponding values of said two sequences.

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5. The method of claim 3, wherein said carrier frequency deviation is determined as follows:

$$\Delta f = \frac{1}{2\pi \frac{L}{2} T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \tilde{r}\left(k+\frac{L}{2}\right)\cdot \tilde{r}^{*}(k)\right) \quad \text{(Eq.13)}$$

wherein $\tilde{r}$ designates values of said portions;

$\tilde{r}^*$ designates the complex conjugate of said values of said portions;

T_{MCM} designates the duration of said useful symbol;

k designates an index; and

L designates the number of values of said two sequences of said reference symbol.

6. The method of claim 4, wherein said carrier frequency deviation is determined as follows:

$$\Delta f = \frac{1}{2\pi \frac{L}{2} T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \left[\tilde{r}\left(k+\frac{L}{2}\right)\cdot \tilde{r}^{*}(k)\right]\cdot\left[S_{AM}(k)S_{AM}^{*}\left(k+\frac{L}{2}\right)\right]\right) \quad \text{(Eq.14)}$$

wherein $\tilde{r}$ designates values of said portions;

$\tilde{r}^*$ designates the complex conjugate of said values of said portions;

T_{MCM} designates the duration of said useful symbol;

k designates an index;

L designates the number of values of said two sequences of said reference symbol;

S_{AM} designates values of said identical sequences; and

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S^*_{AM} designates the complex conjugate of said values of said identical sequences.

7. The method according one of claims 1 to 6, wherein said signal is an orthogonal frequency division multiplex signal.

8. The method according to one of claims 1 to 7, further comprising the step of performing a fast automatic gain control of said received down-converted signal prior to the step of performing said amplitude-demodulation.

9. The method according to one of claims 1 to 8, wherein the step of performing said amplitude-demodulation comprises the step of calculating an amplitude of said signal using the $alpha_{max+}$ $beta_{min-}$ method.

10. The method according to one of claims 1 to 9, further comprising the steps of sampling respective amplitudes of said received down-converted signal and comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence in order to perform said amplitude-demodulation.

11. The method according to claim 10, wherein the step of sampling respective amplitudes of said received down-converted signal further comprises the step of performing an over-sampling of said received down-converted signal.

12. An apparatus for performing a coarse frequency synchronization compensating for a carrier frequency deviation from an oscillator frequency, for a demodulation system (130) capable of demodulating a signal having a frame structure, said frame structure comprising at least one useful symbol (162) and a reference symbol (166), said reference symbol being an amplitude-modulated bit sequence, said apparatus comprising:

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receiving means (132) for receiving said signal;

a down-converter for down-converting said received signal;

an amplitude-demodulator for performing an amplitude-demodulation of said down-converted signal in order to generate an envelope;

a correlator for correlating said envelope with a predetermined reference pattern in order to determine said carrier frequency deviation; and

means for controlling said oscillator frequency based on said carrier frequency deviation.

13. The apparatus of claim 12, comprising means for determining said carrier frequency deviation as follows:

$$\Delta f = \frac{1}{2\pi T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \tilde{r}(k) \cdot S^{*}_{AM}(k) \right) \quad \text{(Eq.6)}$$

wherein $\tilde{r}$ designates values of said envelope of the received signal;

S^{*}_{AM} designates the complex conjugate of the values of the predetermined reference pattern;

T_{MCM} designates the duration of said useful symbol;

k designates an index; and

L/2 designates the number of values of the reference pattern.

14. An apparatus for performing a coarse frequency synchronization compensation for a carrier frequency deviation from an oscillator frequency, for a demodulation

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system (130) capable of demodulating a signal having a frame structure, said frame structure comprising at least one useful symbol (162) and a reference symbol (166), said reference symbol (166) being an amplitude-modulated bit sequence which comprises two identical sequences (300), said apparatus comprising:

receiving means (132) for receiving said signal;

a down-converter for down-converting said received signal;

an amplitude-demodulator for performing an amplitude-demodulation of said down-converted signal in order to generate an envelope, said envelope having two portions which are based on said identical sequences (300);

a correlator for correlating one of said portions of said envelope with another one of said portions in order to determine said carrier frequency deviation; and

means for controlling said oscillator frequency based on said carrier frequency deviation.

15. The apparatus of claim 14, wherein said correlator comprises means for weighting of corresponding values of said two portions with corresponding values of said two sequences (300).

16. The apparatus of claim 14, comprising means for determining said carrier frequency deviation as follows:

$$\Delta f = \frac{1}{2\pi \frac{L}{2} T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \tilde{r}\left(k + \frac{L}{2}\right) \cdot \tilde{r}^{*}(k) \right) \qquad \text{(Eq.13)}$$

wherein r designates values of said portions;

r^* designates the complex conjugate of said values of

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said portions;

T_{MCM} designates the duration of said useful symbol;

k designates an index; and

L designates the number of values of said two sequences of said reference symbol.

17. The apparatus of claim 15, comprising means for determining said carrier frequency deviation as follows:

$$\Delta f = \frac{1}{2\pi \frac{L}{2} T_{MCM}} \arg\left(\sum_{k=1}^{\frac{L}{2}} \left[\tilde{r}\left(k + \frac{L}{2}\right) \cdot \tilde{r}^{*}(k) \right] \cdot \left[S_{AM}(k) S_{AM}^{*}\left(k + \frac{L}{2}\right) \right] \right) \qquad \text{(Eq.14)}$$

wherein $\tilde{r}$ designates values of said portions;

$\tilde{r}^{*}$ designates the complex conjugate of said values of said portions;

T_{MCM} designates the duration of said useful symbol;

k designates an index;

L designates the number of values of said two sequences of said reference symbol;

S_{AM} designates values of said identical sequences; and

S^{*}_{AM} designates the complex conjugate of said values of said identical sequences.

18. The apparatus according to one of claims 13 to 17, wherein said signal is an orthogonal frequency division multiplexed signal.

19. The apparatus according to one of claims 13 to 18,

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further comprising means for performing a fast automatic gain control of said received down-converted signal preceding said amplitude-demodulator.

20. The apparatus according to one of claims 13 to 18, wherein said amplitude-demodulator comprises means for calculating an amplitude of said signal using the $alpha_{max+}$ $beta_{min-}$ method.

21. The apparatus according to one of claims 13 to 20, further comprising means for sampling respective amplitudes of said received down-converted signal, wherein said amplitude-demodulator comprises means for comparing said sampled amplitudes with a predetermined threshold in order to generate a bit sequence.

22. The apparatus according to claim 21, wherein said means for sampling comprises means for over-sampling said received down-converted signal.

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